



Towards a simplified performance-linked value for money model as a reference point for bus contract payments

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ABSTRACT

The burgeoning commitment to contracting the delivery of bus services through competitive tendering or negotiated performance-based contracts has been accompanied by as many contract payments schemes as there are contracts. We are now well placed to design a simplified performance-linked payment (SPLP) model that can be used as a reference point to ensure value for money, given the accumulation of experiences throughout the world which have revealed substantive common elements in contracts. Whether the payment to the operator is framed as a payment per passenger or as a payment per service kilometre, the SPLP identifies efficient subsidy outcomes that are linked to a proxy indicator of net social benefit per dollar of subsidy. We illustrate how the SPLP model can be applied to obtain the gross (subsidy) cost per passenger (or per passenger km) from measures of gross cost efficiency and network effectiveness. This model can then be used as part of a benchmarking activity to identify reference value of money prospects in respect of passengers per \$ subsidy outlay by adjusting for influences not under the control of the service provider. A single framework to identify contract payments to operators, and to assess (i.e., benchmark) operator performance on critical KPIs, is provided by internalising critical key performance indicators (KPIs) in the design of the SPLP. The proposed SPLP model is sufficiently general to be independent of the procurement method (competitive tendered or negotiated, for example) and of the treatment of revenue allocation (net or gross based contracts), with the additional advantage of being able to assess value for money for government.

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1. Background

Since the first Thredbo conference in 1989 (see Hensher, Beesley, & Battellino, 1991), we have seen an explosion worldwide in reforms to the provision of local bus services. At each conference we identify additional locations beginning their reform agenda that involves, to varying degrees, a move away from a predominantly public monopoly supply, and a greater engagement in contracting reforms (see Bakker & van de Velde, 2009; Hensher, 2007; Hensher & Houghton, 2004; Hensher & Stanley, 2008; Hensher & Wallis, 2005; and Stanley & van de Velde, 2009). These reforms vary from economic deregulation through to competitive tendering and negotiated contracts, with different amounts of performance-based prescription. Countries and jurisdictions within countries, engaged in institutional reforms in service delivery for many years, are seen to sway back and forth between the regimes as they 'learn' from their own experiences as well the experiences of others. As an example,

we see a proposal to return to economic deregulation in Sweden, after employing competitive tendering for the last 15 years; it is however economic deregulation with a twist.¹ This paper relates to

¹ The Swedish Public Transport Authority (PTA) will design a services statement expressing demand for services, including strategic goals. Operators then apply for commercial based services, and the PTAs evaluate applications with respect to the goals set in the services statement. Some commercial traffic results and the non-commercial services will be tendered as Public Sector Obligations. This is controversial: there is a fear that co-ordinated services will be fragmented, that cherry picking will occur, and the prevention of cross-subsidy will increase costs to society. Some observers believe that this scheme is more about controlling cost than improving services and increasing passengers. Some proponents believe that commercial and non-commercial services can co-exist, as in the UK model outside of London; although the current financial stringency is showing how this model makes it easier to 'cut' non-commercial services requiring subsidy. A long term concern is that the removal of cross subsidy through deregulation may well have equity impacts if non-commercial services are cut back through the need to meet budget constraints. The New Zealand experience with economic deregulation has not been as good as the UK with commercial services focussing only on the peak, and the incumbent peak service provider successfully winning non-commercial tendered services in the off-peak, offloading all shared costs to the tendered services because there are insufficient competing bids to prevent this happening.

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contracts for services for which an Authority makes a payment and does not relate to commercial services in a deregulated environment.

Some core elements of the contract payment regime can be identified by looking at the diverse range of procurement and payment mechanisms used to contract the provision of bus services (see Wallis, Bray, & Webster, 2010; Wallis & Hensher, 2007). Despite the heterogeneity of such payment methods, these core elements are characterised by mixtures of demand and supply criteria in both baseline and incentive linked contracts.

Candidate payment models can be classified as:

- (i) A pure cost-based model associated with cost per bus kilometre and no patronage or service incentives,
- (ii) A hybrid model based on (forecast) patronage allocation and residual cost per bus kilometre without incentives,
- (iii) A pure cost-based model with patronage and/or service incentives, and
- (iv) A hybrid model with patronage and/or service incentives.

A pure gross cost-based model associated with cost per bus kilometre is typically the conversion of a total cost, and is determined by the operating environment and efficiency of scheduling. The operating environment varies for many reasons, but the key cost drivers include average speed, spread of service hours over each weekday and weekend, vehicle utilisation,² dead running time, fleet financing (noting that a contract under negotiated performance based contracts must have agreed terms of depreciation, risk and economic life of assets; in contrast under competitive tendering when operators put this into their bids), and scheduling efficiency issues such as layovers between trips which are often influenced by the degree of union influence in scheduling, but which is likely to affect vehicle scheduling as well.

Patronage and service kilometre incentive payments also exist in a growing number of contracts, and are based on a range of approaches. In simple terms, the patronage incentive payment is linked to growth in patronage above an agreed benchmark; and service kilometres in these cases must be related to some gain in patronage otherwise it is an inefficient (and ineffective) cost driver.

Some contracts are net and others are gross. A net contract is where operators retain fare box revenue and bid for, or negotiate a (net) subsidy. In contrast, under a gross contract an operator bids or negotiates for the total cost of operating a pre-specified service, and the Authority retains the fare box revenue. Performance incentives, more commonly aligned with gross contracts, are typically related to reliability and other input measures for service quality, but can also include patronage-based incentives. Allocating and managing the revenue risks and uncertainties is the significant issue in contract design. Gross contracts have some advantages over net contracts; in particular they remove one of the barriers to entry, as new entrants³ generally have significantly less information (especially information on patronage and revenue potential) on which to base their tender or negotiated prices. A gross contract also facilitates the introduction of integrated fares⁴ because it

removes the need to allocate the revenue between operators and modes, but with gross contracts, the patronage-related risk is on the side of the Authority. In contrast operators have generally a greater incentive for patronage growth if the contract is net, because in keeping the fare box revenue they gain from the revenue of any additional passengers generated.

We have not seen a net cost tender where bidders were provided with an accurate picture of the current revenue and/or patronage. This means that net cost tenders will have a high risk premium for non-incumbent bidders, and this in turn gives a strong advantage to the incumbent. That is in large measure how NZ Bus has been able to maintain their effective monopoly in Auckland⁵ and Wellington for so long. Net cost contracts also have a higher risk to “network integrity” where operators put too much focus on their own position (especially where it operates within and between contract areas) without considering their role as part of the wider network.

Given the accumulation of experiences throughout the world, that have revealed substantive common elements in contracts, we are now well placed to design a simplified performance-linked payment (SPLP) model that can be used as a reference point to ensure value for money to government. Whether the payment to the operator is framed as a payment per passenger or as a payment per service kilometre, the SPLP identifies efficient subsidy outcomes that are linked to a proxy indicator of net social benefit per dollar of subsidy.

In this paper we set out the SPLP model and illustrate how it can be applied to obtain the gross (subsidy) cost per passenger (or per passenger km) from measures of gross cost efficiency and network effectiveness. This model can then be used as part of a benchmarking activity to identify reference value for money prospects in respect of passengers per \$ subsidy outlay by adjusting for influences not under the control of the service provider. A single framework to identify contract payments to operators, and to assess (i.e., benchmark) operator performance on critical KPIs, is provided by internalising critical key performance indicators (KPIs) in the design of the SPLP. The proposed SPLP model is sufficiently general that it is independent of the procurement method (competitive tendered or negotiated, for example) and the treatment of revenue allocation (net or gross based contracts), with the advantage of being able to assess value for money to government.

The paper is structured as follows. We begin with an outline of the proposed SPLP model, presented in the absence of any consideration of benchmark references. This defines the baseline value for money position. We then propose a way to determine the extent to which the baseline value for money defined in terms of passenger per \$ of subsidy outlay satisfies a performance benchmark standard to ensure that the operator awarded a contract satisfies the status of an efficient service provider. Confirmation of this status requires a comparison of operators in similar operating environments, after controlling for factors that are not under the control of the operator. We finish with some concluding comments.

2. A proposed simplified performance-linked payment (SPLP) model

We start with the assumption that an Authority such as government defines the budget (B) for services (regardless of

² Similar to the cost allocation formula used to use for costing contracts in Britain before competitive tendering, which allocated costs according to three variables – bus kilometres, bus hours, and peak vehicle requirements.

³ In the UK this did not deter new entrants – if they get it really wrong, they bow out of the contract and it is retendered. It is a steep but fast learning curve with information out there on successful contracts to use for information. Having said this, it does lead to less stable outcomes in the short run.

⁴ Although it has been shown in Holland, France, and the UK that patronage surveys of an ongoing nature are acceptable as a way of allocating revenue. In Sydney, for example, gross contracts still seem to inhibit integrated fare because of the unsubstantiated claim by government that different modes ‘need’ to have receipt of the flagfall fare component.

⁵ Although this is exacerbated by cherry picking of commercially attractive peak services which led to the residual off-peak services being tendered out and won in almost all situations by the incumbent operating the peak commercial services (utilising the opportunity to ‘allocate’ all shared costs to the tendered services in order to benefit from the lack of competition in the bid process). The contracting position in New Zealand is set to change with the intention of ameliorating this situation.

whether a contract is gross or net), sets minimum standards (X) and a growth target (G). The minimum standards would be based on passengers per bus kilometre (or passengers per operating hour to allow for traffic congestion),⁶ as the key objective of service delivery. We also assume that bidders (if competitively tendered) or negotiators (typically an incumbent) would have access to 'relevant and reliable' data on the current services and patronage on which to base their 'offer' to the Authority.⁷

The offers should be in the form of either a required dollar compensation per passenger, or a dollar cost per kilometre, with the latter being linked back to an overall performance outcome defined as \$/passenger or \$/passenger km. The dollar subsidy per passenger or dollar subsidy per passenger kilometre is the primary measure of value for money from an Authority perspective. The inverse of this metric is a reasonable proxy for net social benefit per dollar of subsidy outlay, treating patronage levels as the representation of benefit to society of the subsidy investment. This was the UK justification in the 1970s of maximisation of passenger miles as a good proxy for maximisation of social welfare (see Nash, 1978).

The contract payment formula below shows how the operator is assessed in terms of the value for money received from subsidy payments, even if the operator negotiates with the Authority on the basis of a total cost per kilometre contract fee. In the latter case, the contract delivery formula has an explicit recognition of the effectiveness of the subsidy payments given the objectives of value for money in delivering services to existing and potential passengers and realistic budgetary disciplines through budget caps designed to avoid financial problems for the Authority.

To enable the Authority to budget effectively, the total contract value would have to be capped at a figure that represents an agreed growth target. This recognises a need for sufficient financial flexibility to reward growth in patronage above baseline projections. This is a tricky area as most Authorities appear to budget on the assumption that their initiatives to promote public transport will not reach agreed targets, and are often surprised when growth actually occurs and leads to a demand for more resources. It has been our experience that growth can be extraordinarily variable on adjacent corridors, and is always far higher or far lower than expected. Predicting patronage appears to be a "black art" that no-one has a good handle on, except in an aggregated way (city wide). An "agreed growth target" should be a network target, and have the flexibility to handle variations between existing contractors.

In the SPLP model we assume that the operator would have relative freedom to plan services⁸ except that:

- (i) Any decision to lower standards under the minimum set out in the contract would need agreement of the Authority;
- (ii) The Authority could require that services with lower passengers per bus kilometre (or per bus hour) be introduced either as a "kick start" or permanently, but only by paying fares that

builds the patronage up to the defined (or agreed) minimum of passengers per bus kilometre (or per hour)⁹;

- (iii) The operator would have the freedom to grow services, with a requirement to note the priorities set by the Authority; and
- (iv) Where peak vehicle requirements are often dictated by the local market, this should be additionally included as recognition of the implications of peak vehicle requirements on bus utilisation.

This approach, we suggest, should remove second guessing and detailed analysis, and sends all the right market signals. It motivates the operator, but also protects the Authority. It is simple to bid (or negotiate), simple to assess, and simple to manage. In the right hands (always a caveat) this could lead to rapid progress towards the Authority's targets.

This payment mechanism can be formally set out as follows (with elements in bold set by the Authority). We develop the formula using \$/bus km, but the approach can also use a more general cost formula which distinguishes costs in terms of \$/km, \$/hour and \$/peak bus and which, if preferred, can be defined in terms of bus hours. The ultimate target in all cases is the identification of \$/passenger (or \$/passenger km). We develop the formula in terms of passengers.

Define the Budget:

$$B = \text{\$/passenger} \times \text{number of passengers} \quad (1)$$

subject to

$$\text{passengers/bus km} = X \quad (2)$$

and

$$B_{\max} = \text{\$/passenger} \times \text{number of passengers} \times \text{growth rate target} \quad (3)$$

B , X , and growth rate target are set by the Authority and can be annual or over the lifetime of the contract. B_{\max} has to be capped because it is the mechanism available to ensure that Treasury can fund the services under the contract. If passengers/bus km is less than X , then a shadow fare will apply for the gap, as long as the Authority agrees on X and is persuaded that achieving the target is due to influences not under the control of the operator.¹⁰ The shadow fare might be defined as equal to the (actual fare * passengers per bus km)/ X . X as a minimum level of service provides operators with opportunity to argue for extensions of their network but with the caveat that the change must satisfy X . Equation (2) is a useful management tool for operators to assist them in identifying where they might build up services, be it at a route level or some more aggregated level, allowing identification also of likely impact on overall cost per passenger.

The number of passengers has to be predicted from previous periods (or demand studies in the case of new services), and agreed

⁶ Some commentators have suggested that passenger kilometres would be a better measure than simply using passengers per bus km. Whilst we agree in general, that passengers km is a better measure than simply the number of passengers, in the formulae developed below, this would require measurement of passenger km per bus km which would not add any new information over passengers per bus km since the distance is a constant.

⁷ If it is a negotiated context, then the incumbent is the same as the negotiating operator; if it is a competitive bid, then this is not the case. In some jurisdictions, historical patronage figures are available in the public domain or in a contract specification; but this is not common practice when the contract is being negotiated, as opposed to being subject to a competitive bid.

⁸ While recognising the increasingly political nature of bus services.

⁹ Given that many cities are moving to centralised revenue collection by Government, and the use of city-wide smart cards, the actual "fare" has little meaning to the contractor. If these fares vary between types of travel, e.g., they are paid for initial boardings, but not subsequent boardings as in Perth, or there are differentials between types of passenger – e.g., adults and pensioners, then these differences will distort the way operators develop services. This "fare" is really a management tool for incentivising the contractors.

¹⁰ Passengers per bus km can vary enormously over a common network, and there are always many politically valuable services that will have very low passengers per bus km. There are areas where the variation in passengers per bus km between routes within one contract area is 10:1. However, we anticipate passengers per bus km would be agreed as applying to an operator's entire network rather than an individual route.

by all parties. A mix of passengers should be allowed for, including schoolchildren who in some jurisdictions travel for free on passes (and are treated as half fare). Passes on issue will have to be quantified in an appropriate way to obtain estimates of passengers/bus km, and this simplified contract provides an incentive to all parties to agree on this.

The cost per passenger is a composite of \$/bus km (i.e., cost efficiency (CE)) and passengers per bus km. (i.e., network effectiveness (NE) – see formula (4)). These two key performance indicators (KPIs) are arguably the main drivers of performance, and hence contract specification and compliance.¹¹ That is, NE/CE = passengers per \$ outlay of subsidy. Alternatively the inverse (i.e., network effectiveness/cost efficiency) is a measure of the amount of subsidy outlaid per passenger, which is the gross measure of value for money in the absence of any comparative assessment of value for money through benchmark checks (see below).

$$\frac{\$}{\text{passengers}} = \frac{\left(\frac{\$}{\text{bus km}}\right)}{\left(\frac{\text{passengers}}{\text{bus km}}\right)} \quad (4)$$

The cost per kilometre should be indexed for inflationary changes by CPI_{adj}, the consumer price index adjustment factor per annum and must reflect important cost components such as wage and fuel costs. We recognise that indexation by the CPI is very inaccurate as a reflection of costs, especially when wages increase faster than the CPI, which is common in many jurisdiction (e.g., 1–1.5% per annum in Australia), and fuel can be very volatile. An indexation approach that is more cost-specific, in general, should be used if it is available.¹²

3. Establishing benchmark value for money outcomes

The SPLP model set out above identifies the subsidy outlay per passenger based on a gross measure of cost efficiency and network effectiveness. “Gross” refers to all elements regardless who has control over them. This does not ensure that we have a value for money outcome to the Authority. To identify this requires a further stage in which we benchmark the gross measure of subsidy per passenger against a measure of ‘best’ or ‘minimum acceptable’ practice. That is, we need to control or standardise for influences that are not under the control of each operator so as to compare the performance of operators in their operating environment. The net measures of cost efficiency and network effectiveness resulting from this standardisation then enable a gross measure of subsidy per passenger to be established that can be compared with an agreed benchmark, so that the Authority has confidence that the contract will deliver the contracted services as a value for money outcome.

Adjusting gross cost efficiency by controlling for (or standardising on) those influences not under the control of the operator is the focus of this section. Each operator will face contextual effects over which they have no control (for example congestion which affects speed) which is adjusted by applying a formula such as that

given in (5). This formula is a way of recognising, and allowing, for differences in costs that vary by the hour and the peak bus requirement, that are the basis of payment models based on \$/bus km plus \$/bus hour plus \$/peak bus.

$$\frac{\$}{\text{bus km}} = f \left(\begin{array}{l} \text{average peak speed, spread of service hours,} \\ \text{vehicle utilisation, peak vehicle requirements} \end{array} \right) \times \text{Annual CPI}_{\text{adj}} \quad (5)$$

Whilst (5) relates to cost efficiency (the denominator of the equation in (4)), passenger/bus km as a measure of network efficiency (the numerator in (4)) may similarly be subject to influences not under the control of the operator if the Authority is persuaded that achieving the target is due to influences not under the control of the operator). We leave a development to include examining the standardisation of network effectiveness to future research.

We have in previous research identified a number of operating environment features that are reasonably not under the control of the operator. These are speed (based on average timetabled speed), spread of service hours, and bus utilisation. The point of these adjustments is to focus on the ‘offer’ where efficiency and effectiveness of service provision is under the control of the operator, and to standardise the offers for factors outside the operators’ control. These three operating elements (plus the PVR) are typically context-specific influences, and have been found by the authors to be the key drivers¹³ of the differences between operators in gross cost per service kilometre and, to some extent, patronage.

Each of these factors identified above is directly impacted by the operator’s network plan, which is often under the control of the Authority (certainly under route contracts, but also in most area-wide contracts). Statistical analysis in Australia, for example, has shown that average peak speed is a major influence on differences in gross cost per bus kilometre efficiency across contract areas within a given geographical location. The UK practice, prior to economic deregulation, calculated payments for network subsidies on the basis of \$/km plus \$/h plus \$/peak bus,¹⁴ confirming that these adjustments have long been regarded as sensible adjustments for key cost drivers. This is justified in more detail as follows¹⁵:

- *Average speed.* Slower average peak speed, due to traffic congestion and/or an inefficient on-board fare payment system (see Tirachini & Hensher, 2011), for instance, will typically

¹³ Although the cost of delivering services is influenced by many factors, we believe these three key influences impact in a non-marginal way, and cannot be materially adjusted by the operator. That is, they are the result of the external environment, be it geographical, socio-economic, or institutional.

¹⁴ We thank Chris Nash for reminding us of this practice.

¹⁵ The calculation of these influences will vary from jurisdiction to jurisdiction. For example Transperth uses a simple model to calculate average speed using public timetables. This is an automatic output of their contract management model (TRIS), and leads to a simple contract adjustment every 12 months. One common way of calculating speed is as follows: Distance, based on route bus kilometres services arriving at the terminal between 0700–0900 and 1500–1800 h, is the road centreline from a GIS Spatial layer Map, calculated using the shortest path algorithm between stops. The elapsed time is the end of trip time minus start of trip time, and speed is the ratio of distance divided by travel time. To calculate the spread of service vehicles hours, one way is as follows: define route bus services (excluding school services) arriving at the terminus between the start and end times of 0000–0700 h, 0700–1900 h, and after 7 pm on weekdays, and separately for all of Saturday and all of Sunday. The publicly available timetable can be used to obtain actual hours of service and then the annual total hours can be calculated based on the number of School days, Weekdays, Sundays/Public Holidays and Saturdays.

¹¹ We would suggest that the three main KPIs should be cost efficiency (gross and net), network effectiveness (gross and net) and customer satisfaction where benchmarking of performance is undertaken. Additional measures such as safety should be part of minimum compliance standards and separated from performance metrics.

¹² However, a related issue here is subsidy leakage (and one of the strong arguments for economic deregulation). Allowing for the specific effects of wage increases in particular means that there is less incentive for the operator to be harsh about trying to contain wages.

increase driving time and operating costs.¹⁶ This is true whether a peak speed or a speed for all services is used, where the latter can be a weighted average to reflect the distribution of average speeds by time of day if such data is available.

- *Spread of operating hours.* A higher ratio of timetabled operating hours during periods when penalty rates of labour pay apply (e.g., weekends and possibly very early in the morning on weekdays (e.g., before 5 am)), will typically increase operating costs.¹⁷ Non-timetabled school services should be included (if they are part of a contract), since in many jurisdictions, operators have a high incidence of such activity.
- *Average bus utilisation.* A higher number of annual service kilometres per peak bus, because of higher timetabled route frequencies, will typically lower unit costs through diluting fixed costs.¹⁸ Although only a small proportion of cost might be considered to be actually fixed (e.g., bus registration and third party insurance), other overhead costs will increase with activity (even if not in direct proportion), especially where there is a significant increase in kilometres. This suggests bus utilisation on route buses is less likely to be under the operator's control. However, in some jurisdictions the peak includes the school peak. Efficient planning and scheduling by the operator can then have a major impact on the peak vehicle requirements (PVR) and therefore bus utilisation. In these situations there is a risk that a higher PVR will provide a higher cost per km simply because more buses have to be provided to handle the needs in this short peak. To account for this latter issue, we should include the PVR as a further adjustment of the operating environment. If there are mixed fleets, then a further adjustment may be required, whether due to maintenance and/or different ages of the fleet.

Formula (5) would need to be calibrated on existing operator data to obtain estimates of unknown parameters that define the role of context-specific influences so that we can subsequently use the model to adjust for these influences that are not under the control of the operator, essentially by replacing operator-specific levels of speed, spread of service hours, bus utilisation and peak vehicle requirements in the model with a median or best practice level that is used to contrast each operator gross cost per km with a benchmark reference level of performance. Such a calibration is presented in **Table 1**.

Data for calibration should desirably come from the local context (such as all operators in a particular city or region), and be collected through a benchmarking program, although this is somewhat rare in most jurisdictions. If multi-operator data are used, then calibration will need to include the possibility of operator-specific effects. On the other hand, if multi-operator data are not available, then some independent advice will be required on what variations in cost per bus km (and passengers per bus kilometre) are associated with each of the factors in **formula (5)**. Alternatively, the use of extra-jurisdiction values could be used to

Table 1Calibration of gross cost per service km (\$/bus-km).^a

Variable	Calibration coefficient
Constant	4.908
Average peak speed	−0.228
Bus kilometres (bus utilisation)	−0.000055
Spread of service hours	7.359
Peak vehicle requirement	0.065
Operator specific dummy variable	−0.0114

^a All parameters are statistically significant at 95 percent level of confidence.

open negotiations, particularly with incumbent operators. It is most unlikely that operators would remain silent if they felt the formula, based on data from outside their environment, is 'out of range' for their operations. For this reason the opening bid from the Authority, where no data exist in the operating environment, should be within the range of what the Authority believes the relevant costs should be.

As an example of how the adjustment may work, let us assume we have two alternative calibrated models,¹⁹ in terms of the formulation of \$/bus above which is expected to cover all expenses, i.e., variable expenses, overheads, depot rent, margin etc., and all annualised capital costs would be calculated using a depreciation formula (e.g., economic life assumptions) used by the Authority (and not a commercial rule based on how an operator wishes to finance and depreciate assets).

The *first calibration* of gross cost per service km (\$/bus km) of **formula (5)** is given in **Table 1**, where the parameters are illustrative²⁰.

−0.228 indicates that every increase in the average speed of one km/hour in the peak reduces gross cost per bus km by \$0.0228; −0.000055 indicates that every extra bus kilometre reduces gross cost per bus km by \$0.000055 (or 5.5 cents/1000 additional km); 7.359 suggests that a ten unit increase in the proportion of service hours during weekdays after 7 pm and weekends (e.g., from 0.2 to 0.3) increases gross cost per bus km by \$0.736; and 0.0065 indicates that one additional peak vehicle adds \$0.0065 to gross cost per bus km, 4.908 is a constant reflecting, on average across all operators, the role of other factors, and −0.0114 is a constant specific to an operator that accounts for other influences that are variations around the average for all operators in the set, that are specific to the operator.

To assess the realism of this simplified formula, we applied the parameter estimates of **Table 1** to data from a number of operators in Australia. In comparing the \$/passenger outcome using the parameter estimates with data from actual operators we found the calibration of **formula (5)** (shown in **Table 1**) was able to reproduce the actual amount of money received by operators from the Authority to within ±five percentage points.²¹ Such a variation might reasonably be built into the margin of the 'offer'.²² We

¹⁹ The parameter estimates used are not exact for any specific operating context, but are indicative of what we believe are reasonable estimates in metropolitan Australia.

²⁰ The importance of noting the illustrative nature of the example is crucial. To emphasise this, we might have also selected a situation where the passenger/bus km ratio is 1.4 (as in Adelaide). We have used 10 in our example, which may be too high in many situations.

²¹ The data used is confidential; however we thank the specific operators who wish to remain anonymous for providing data to enable the calculations.

²² We received a comment that "5% error in reproducing actual payments would represent a substantial part of the operator margin of a third or more" (John Stanley, personal communication). We recognise there is a risk in this approach, and would prefer a mechanism where the onus is put on the operator to show why this approach should not be used. This could be done in negotiation. In principle, if the operator cannot show this, how do they know their margin is affected?

¹⁶ It could be argued that slower speeds can also be the result of poor timetabling practices, which are under the control of the operator. However we believe the impact of slower speeds imposed by external factors in the operating environment will dominate here.

¹⁷ A greater spread of operating hours, along with increased midday off peak services, can allow the operator to build more straight, rather than broken shifts. This could lower wage costs per hour given wage agreements.

¹⁸ We acknowledge that average vehicle utilisation could vary substantially over a contract period, especially in situations where for example government pumps extra buses into the network, but then restricting kilometres to those buses. For example, the 300 growth bus strategy in Sydney targeted kilometres at the peak, and kilometres attached to the growth buses was often half the km/bus of the existing fleet.

therefore deem this adequate as a starting position for negotiation or bid assessment.

From the calibration shown in Table 1, the next task is to identify a benchmark reference estimate of gross cost per km from a sample of operators in a pre-defined jurisdiction to show how the SPLP would operate. Let us assume that for all operators that the average peak speed is 20 kph, average vehicle utilisation is 40,000 km per annum per bus, the spread of service vehicle hours is 0.2 (i.e., 20 percent are after 7 pm on weekdays plus all of Saturday and Sunday), the PVR is 80 buses, and the cost index adjustment is 1.02. Then the application of the figures in Table 1 results in a gross cost/bus km of $(-0.01140 - 0.0228 * 20 - 0.000055 * 40,000 + 7.359 * 0.2 + 0.0065 * 80 + 4.908) * 1.02 = \4.32 per bus km. Assuming average passengers/bus km = 10 (which might satisfy the minimum X level in equation (2)), the \$/passenger estimate applicable in equations (1) and (3) is \$0.432. If the average is less, such as close to 1 in Sydney, then the \$/passenger estimate is \$4.32.

We also considered, but rejected as inferior,²³ another way of establishing the cost efficiency component of the formula as a calibrated model, in which variations around the average performance of all operators in the predefined geographical context (equation (6)) were identified. This *second specification* of gross cost per service km (\$/bus km) is given as formula (6), with the actual calibrated model given in Table 2, excluding the peak vehicle requirement.²⁴

$$\text{Gross cost per bus km} = f \left[\begin{array}{l} (\text{Average operator peak speed} - \text{all operators averaged peak speed}), \\ \left(\text{Operator } \frac{\text{km}}{\text{bus}} - \text{average all operator } \frac{\text{km}}{\text{bus}} \right), \\ (\text{operator spread of service hrs} - \text{average of all operators spread of service hrs}) \end{array} \right] \quad (6)$$

This model produces estimates of gross cost per bus km that are close to current values with the values for each operator being calculated by the inclusion of an operator specific constant. Most of the estimates vary by no more than \$0.5/km, (which might deemed substantial in a typical range of \$3/km to \$7/km) but whilst simpler than using equation (4), this is less accurate.

4. Using the benchmark value for money outcomes

Putting the SPLP into operation requires that each operator will be assessed against a benchmark identified in the previous section to ascertain if the operator satisfies the conditions for cost efficiency. If the operator does satisfy cost efficiency, this can be then linked to an agreement on network effectiveness and hence to an agreement on passengers per \$ of subsidy outlay. Given the total forecast patronage, the budget can be calculated. Adding to this the Authority's approved growth rate target (equation (3)), the maximum available budget can also be calculated for the Authority taking account of the contract for each and every operator.

In identifying a benchmark, either an individual operator calibration can be used if available. Alternatively, an operator can be

Table 2
Calibration of gross cost per bus km (\$/bus km).^a

Variable	Calibration coefficient
Constant	6.11187
Average operator peak speed – all operators averaged peak speed	–0.16843
Operator km/bus – average all operators km/bus	–0.00015
Operator spread of service hrs – average of all operators spread of service hours	1.17412

^a All parameters are statistically significant at 95 percent level of confidence.

assessed as if they were operating at best practice, with an 'average for all operators \$/bus km' being replaced with best practice or median level.²⁵ This estimate is then multiplied by passengers/bus km to obtain \$/passenger, which together with forecast patronage, provides an estimated budget as a starting position for negotiation or bid evaluation.

5. Conclusions

This paper promotes the idea that it is possible to develop a simplified formula for identifying the amount that a local bus operator should be paid under a gross or net contract to deliver a given level of service. The essential ingredients are few, but crucial: these are the gross cost per bus km (or an equivalent

measure based on bus km, bus hours and peak bus requirements), the patronage per bus km, and the consequent (subsidy) cost per passenger. Given patronage forecasts, a contract budget can be determined. The gross cost per bus km can be established using local data on operators who provide similar services, adjusting for differences in the operating environment as a way of ensuring that the agreed gross cost per bus km is an efficient cost.

It should be emphasised that a contract between an operator and Authority can still be couched in terms of a \$/km amount, but the delivery model is in terms of an expected \$/passenger (or \$/passenger km if such data were available) given budget and budget caps. We are proposing a model that can monitor performance in terms of value for money associated with each \$ of subsidy, and we are arguing that a practical way of achieving this is by linking the subsidy to patronage. Value for money in the contractual regime is achieved by the cost efficiency as an input, working with a measure of network effectiveness.

Despite the appeal of the SPLP model, with such simplification comes a potential risk that other factors not explicitly considered

²³ We suspect this is the case because it is in most cases almost impossible to get the data from all operators (there are always some bids missing, as is evidenced in the UK and even more so in Germany).

²⁴ The peak vehicle requirement is only excluded because we have not identified a parameter estimate, but would otherwise be included in a real application.

²⁵ We recognise that benchmarking involves comparing not just operators but their operational area, and differences could and do derive from both. However, where multiple operators bid for an identical contract area, the price differences can be extraordinarily close – less than one percent between the incumbents, but with some real divergence (both ways) from new entrants. This is why incumbents have survived in most of the re-tenders in Perth and Adelaide, for example. In these situations the costs and risks of changing operators are greater than any benefit derived from the differentials in the tender price.

might also play a role in the cost/bus km.²⁶ All other factors are currently embedded in the overall constant in formulae (5) and (6). To resolve this, operator-specific constants²⁷ (as shown in Table 1) can be used if data of sufficient quality exists to allow for unique constants for each operator. The use of operator-specific constants by the Authority is certainly feasible, but the results could not be made available to all operators, incumbent or otherwise, given the confidential nature of data that would be required. It would also require some careful consideration of the transferability of such constants to situations which vary in the presence of another service provider.

The payment model proposed in this paper fundamentally alters the whole net vs. gross contract discussion. The only real value of a net contract, *from an operator's perspective*, appears to be the incentives it might provide; in all other areas it is a negative (e.g., co-ordinated planning, integrated ticketing, transparent tendering), although such negatives are positives for the Authority. Given that the proposed model has a built-in incentive for both operator and Authority, it can replace both net and gross contract models. If payment (in terms of \$/bus km) is based on the cost/passenger approach, this will not shift the revenue risk to the operator since the negotiating framework is premised on agreed cost outcomes and agreed forecasts of network patronage (with initial estimates of patronage per operator). On the other hand, operators are incentivised to build patronage through the agreement of targets. Importantly too there could be possibilities to modify the final contract to give asymmetric incentives with shortfalls in patronage from the starting base having a different marginal impact as compared to increases in patronage. Fundamentally this is an important issue in an environment where it is difficult for operators to adjust their frequency and/or network in response to declining patronage or in an environment where overall patronage is falling.

We have shown that a SPLP model is a transparent, simplified, formula which has value as a reference point in negotiation of contracts, as first time or upon renewal. Bus Associations can benefit by using this approach to advise potential operators entering into negotiations with the Authority.²⁸ The approach is also valuable in suggesting an objective way of assessing the costs of delivering bus services. This is critically important in critiquing existing systems and determining whether there is a justification for change of operator which can be disruptive.²⁹ It is also useful for the evaluation of competitive tender 'offers' and for developing policy if these do not meet the cost and network efficiency benchmarks of the Authority.

A hope is that the ideas in this paper might move the debate away from the controversial debate on tenders vs. "trusted partnerships" towards how to use the way the private sector works to

maximise the benefits to government and the community (in terms of investing subsidy to delivery patronage). In addition, given what we believe are the key drivers of cost efficiency (or cost per vehicle km or hour), we must express caution about the existence of factors that drive costs that cannot be simply and objectively measured (recognising the dominant role of fuel, wages, and average speed). This may minimise the need for benchmarking in order to make assessments. Time will tell.

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²⁶ There are always variations between jurisdictions. Operators often use this argument as self justification. Once controls are used to measure variations in key inputs (e.g., the cost of fuel and wage levels) then we cannot see why there are any differences other than average operating speeds. The first two can be significant – often as high a differential as 15 percent between Australian cities, and movements in speed can have dramatic impacts on contracts. However if these are allowed for there is likely to be little difference between operating a bus in the different Australian capital cities, for example. We believe that the focus by some operators on their unique environment is a self-serving mythology to protect their profits, their inefficiencies and their security. If an operator can bid in a jurisdiction accounting appropriately for the cost of fuel, wages and average speed, then benchmarking best practice would be identified, which may be better than benchmarks existing with all incumbent operator's in protected domains. Vested interests do not like this.

²⁷ One consultant stated: "I quite like the idea of operator-specific constants as putting the blow torch on the tails of the distribution".

²⁸ We acknowledge the advice of John Stanley.

²⁹ As an example of a not uncommon situation, in a recent contract we are aware of, a bidder came in 10 percent under the incumbent on a contract and the tendering Authority rejected it, using evidence on best practice.